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PISTON-ACTUATED DISPENSING PUMP

Filed Nov. 30, 1964

2 Sheets-Sheet 1

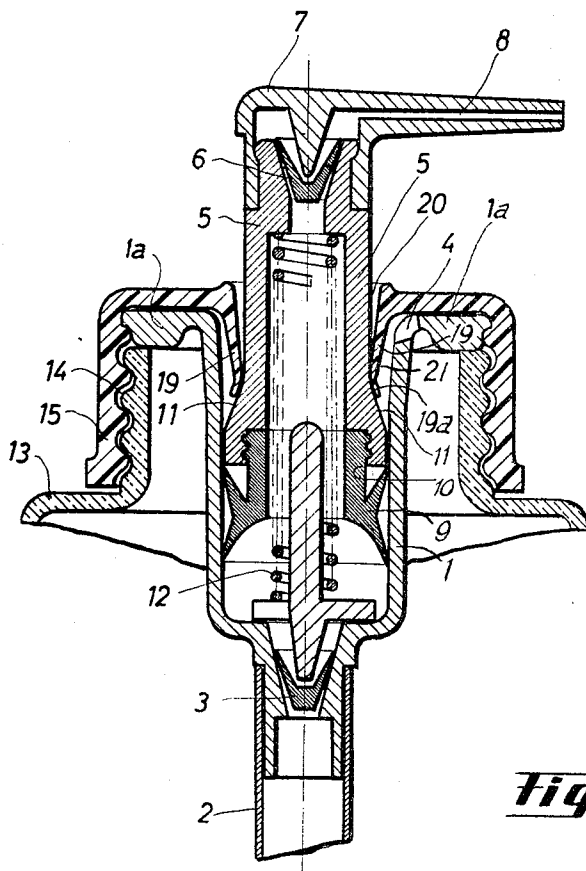


Fig. 1

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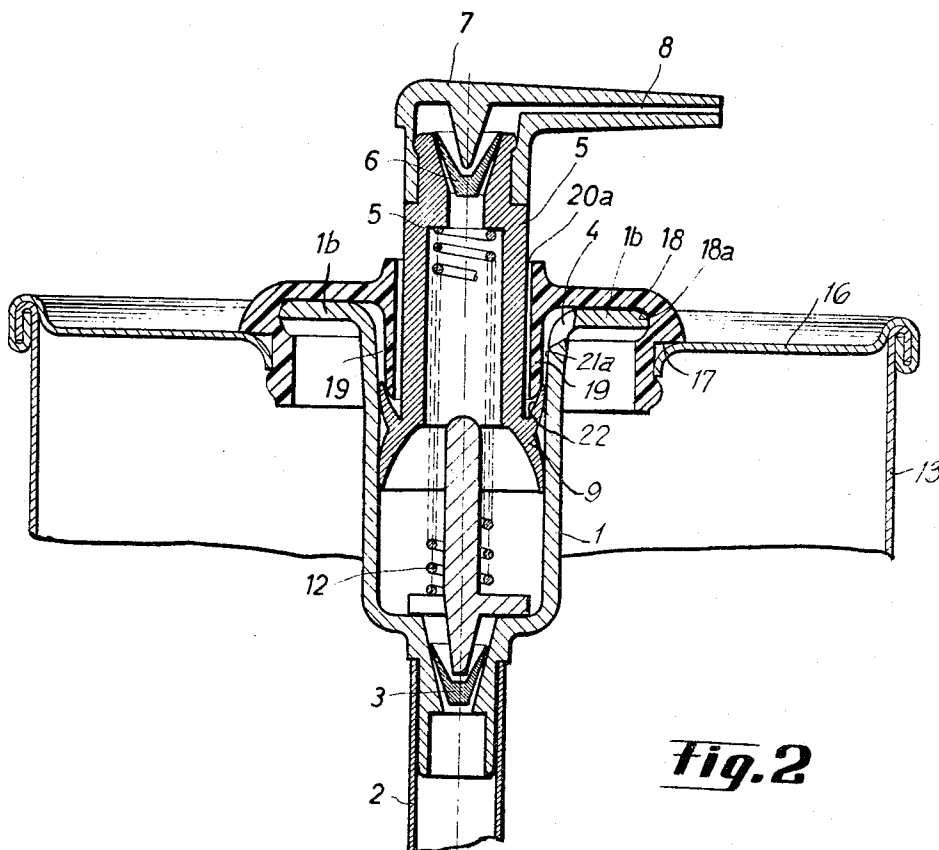


Fig. 2

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PISTON-ACTUATED DISPENSING PUMP

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7 Claims. (Cl. 222—321)

This invention relates to a small piston actuated dispensing pump made of molded or pressed parts of thermoplastic material and serving to discharge small amounts of liquid or paste out of a container, for which the pump serves as a closure member, in which a tubular piston including an elastic sealing collar is guided within a pump cylinder and yieldingly urged outwardly by a spring so as to be operable from the outside, the pump cylinder being connected to the container by a cap, or the like, through which the tubular piston extends.

In small piston operated dispensing pumps of the above mentioned type, which, after the container filled with liquid or paste-like contents has been emptied, are usually discarded with the empty container, sub-atmospheric pressure is developed within the container due to the progressive discharge of the contents. This subatmospheric pressure gradually approaches a vacuum, if the device is completely sealed, whereby a further removal of the container contents by the suction strokes of the pump ultimately becomes impossible. In order to avoid this, atmospheric air must be admitted into the container in order to prevent the generation of sub-atmospheric pressure. To this end known containers are provided with closable air inlet openings whereby a continuous air admittance through the closures is avoided after the pump has been used, and it is also avoided that the liquid or pasteous contents can leak-out if the container is in a lying or tilted position. The need for separate closable container openings is avoided by the invention.

Some known pumps allow air to enter directly into the container due to the provision of suitable clearances for their parts relative to each other, but in this case the container is not tight any more, after the pump has been used, whereby a contents of pasty consistency may harden by the air admittance, or a liquid content may leak out of a horizontal or tilted container.

In view of the known prior art it is an object of the invention to provide a small piston actuated dispensing pump of the above mentioned type in which, after each quantity of liquid has been discharged, assumes a normal condition wherein a perfect sealing of the container contents is obtained automatically, without any additional closures, by the position of the piston of the pump, the sealing being independent of any position the container may assume, and in which on the other hand air is immediately admitted into the container as soon as the pump is actuated.

This problem is solved by the invention in such a manner that in the first described embodiment the closure cap portion of the pump is provided with an elastic annular flange projecting with clearance into the cylinder and surrounding the tubular piston with suitable clearance so as to form an annular gap with the upper inner cylinder wall communicating through an aperture in the upper section of the cylinder wall with the inside of the container, and that in the resiliently outwardly urged position of the tubular piston the lower edge of the annular flange of the cap resiliently engages an annular conical surface of the piston to form a seal.

It is apparent that the construction is such that upon actuation of the pump piston atmospheric air will flow into the container through the space between the tubular piston and the annular flange of the cap and the upper cylinder wall, and through the upper cylinder wall aper-

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ture, and this air intake will be in accordance with the volume discharged, while, after the return of the tubular piston into its outer normal position of rest, the annular flange of the cap elastically engages with its lower edge an annular conical surface of the tubular piston, thereby perfectly sealing the above mentioned venting labyrinth. The annular conical surface may, as will be explained in greater detail below, be a substantially rigid surface on the circumference of the shank of the tubular piston or may be formed by a corresponding surface section of the sealing collar of the piston.

FIGURE 1 is an elevational view in axial section showing a pump embodying the invention including an interiorly threaded closure member for use with a glass bottle or other container having an exteriorly threaded neck.

FIGURE 2 is a view similar to FIG. 1, illustrating a modified form of the invention, the closure member being arranged for use with the appropriately shaped top of a sheet metal container such as a can. A first embodiment of a small piston pump according to the invention is shown in FIG. 1. The pump is made of molded or pressed parts of thermoplastic material. The pump comprises a cylinder 1, formed of thermoplastic material, and which has at its lower end a tubular extension serving to receive a thin-walled suction tube 2 extending down to substantially adjacent the bottom of the container on which the pump is mounted, and within the tubular extension a check valve 3 is arranged. At its upper end the cylinder 1 is provided with a radial flange 1a, and in the corner formed between the cylinder wall and the radial flange at least one aperture 4 is formed in the wall, the operation of which will later be explained. The tubular piston 5, also made of thermoplastic material, carries in its top part a check valve 6. A cap 7 is attached by snap action, or in any other suitable way, to the top end of the tubular piston 5. The cap 7 is provided with a lateral channel 8 for the outlet of the container contents, if of pasty consistency, or with a nozzle (not shown) for spraying liquid contents. The tubular piston 5 is guided by a lower sealing collar 9 slidable within the cylinder 1 and this collar 9 is formed by two oppositely extending lips with a tapering cross sectional shape which diverge upwardly and downwardly with obtuse angle, therebetween, the lips being stressed to bear yieldingly against the inner wall of the cylinder 1. The collar 9 may be formed of thermoplastic material integrally with the tubular piston 5, or as shown in FIG. 1, with an upwardly directed annular extension 10 fitted into an upwardly extending inner recessed bore at the lower end of the tubular piston 5 and provided, for example with circumferential retaining ribs, or other projections, which snap resiliently into corresponding grooves or recesses of the recessed bore wall. By means of this separate formation of the sealing collar and the tubular piston the molding of the parts is facilitated.

Above the collar 9 the tubular piston is, according to the invention, provided with a frusto-conical surface 11 diverging downwardly, the operation of which will be explained hereinafter.

The pump cylinder 1 together with the vertically reciprocable tubular piston 5, which is yieldingly urged upwardly by a helical compression spring 12 into its outwardly directed position of rest, may be connected in different ways to the container 13. If the container 13 has an exteriorly threaded neck 14, as shown in FIG. 1, then the radial cylinder flange 1a seats on the upper edge of the container neck 14 and is then secured by an interiorly threaded cap 15, a cap screw, or the like. If the container 13 is provided with an aperture 17 in the cover surface 16, as shown in FIG. 2, then an annular cap 18 may be formed in such a way that the radial flange 1b of the cylinder 1 engages an inner groove 18a of the cap

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18, while the cap is provided at the outer circumference with an annular groove defining edges which, after the cap has been pressed into the aperture 17, engage around the edge of the aperture.

The cap 15, or 18 respectively, is also made of molded or pressed thermoplastic material, and is, according to the embodiment of FIG. 1, provided with an elastomeric annular flange 19 projecting into the interior of the cylinder and forming together with the outer circumference of the tubular piston 5 an annular gap 20 tapering somewhat conically and preferably resiliently engaging with its lower end 19a the frusto-conical surface 11 of the piston 5. On the other hand, this flange 19 also defines an annular gap 21 around the inner wall of the cylinder 1 and which communicates via the aperture 4 in the cylinder wall with the interior of the container.

If the piston 5 is moved from outside against the action of the spring 12 initially inwardly to perform a pressure stroke and then outwardly to perform a suction stroke the lower edge 19a of the cap flange 19 slides along the piston wall and if in doing so, material is pumped out of the container by the suction stroke, sub-atmospheric pressure will be generated within the container. This sub-atmospheric pressure will lift the lower lip 19a of the flange 19, due to its elastic character, at least partly away from the piston circumference, whereby atmospheric air may flow into the container through the annular gap 20, the annular gap 21, and the aperture 4, thereby compensating the underpressure. As soon as the tubular piston reaches its outermost position, the elastic annular lip 19a of the annular flange 19 of the cap slides onto the frusto-conical surface 11 of the piston 5 sealingly engaging this conical surface, and thereby perfectly sealing the interior of the container against atmospheric air.

In the embodiment shown in FIG. 2 substantially all of the parts are the same as in the embodiment according to FIG. 1 so that the same reference numerals are used for designating similar parts, and merely the sealing of the interior of the container against the atmospheric air is obtained in a different manner. In this case also the cap 18, includes an elastic annular flange 19 projecting into the interior of the cylinder, but in this case it defines with the circumference of the piston 4 an annular gap 20a and with the upper part of the inner wall of the cylinder an annular gap 21a. In this case also the cylinder wall in the upper part is provided with at least one aperture 4. The tubular piston is in this case not provided with a rigid frusto-conical surface 11 as in FIG. 1, but this conical surface is, according to FIG. 2, formed by the upwardly divergent surface 22 of the upper lip of the obtuse-angled sealing collar 9 facing the shank 5 of the piston, and having walls tapering towards the outside and sealingly engage the inner cylinder wall under pretension.

When actuating the piston pump by exerting an axial pressure upon the piston cap 7 the piston together with the collar 9 is shifted within the cylinder against the pressure of the spring 12, and when, during the suction stroke, a corresponding amount of contents are pumped out of the container sub-atmospheric pressure will be generated within the container causing atmospheric air to flow via the annular gaps 20a, 21a and the aperture 4 into the interior of the container, thereby compensating the underpressure. If the tubular piston 5 is returned by the action of the spring 12 into its upper position of rest, as illustrated, the elastic annular flange 19 of the cap slides over the cone surface 22 of the collar 9 and the upper lip of the collar enters the annular gap 21a, whereby a perfect sealing of the interior of the container against atmospheric air is achieved.

By means of the construction according to the invention, moving the piston between its respective positions generates a sub-atmospheric pressure within the container which is compensated by in-flowing atmospheric air. At the same time, a perfect sealing of the interior of the container against atmospheric air is obtained, when the tubu-

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lar piston is in its position of rest. Additionally, the liquid or paste-like contents cannot leak out of the container regardless of its attitude with respect to the vertical. The seal in the position of rest of the tubular piston is obtained by the construction according to the invention even when the cylinder 1, the tubular piston 5, and/or the annular flange 19 deviate from precise circular shape, which will always be more or less the case in molded or pressed parts of thermoplastic material.

What I claim is:

1. A reciprocating piston pump for dispensing pumpable material out of a container, said pump comprising a closure cap for said container, a pump cylinder connected to said cap, check valve means arranged in the bottom of said cylinder, a suction tube extending from the bottom of said cylinder to a location adjacent to the bottom of said container, a tubular piston slidably guided within said cylinder and extending upwardly out of said cylinder, and outwardly through said closure cap, spring means arranged within said cylinder and said tubular piston yieldingly urging said piston upwardly into a normal position of rest, said piston being actuated from outside against the force of said spring means, an elastic sealing collar provided at the lower end of said tubular piston sealingly bearing against the cylinder wall, further check valve means arranged in the upper part of said tubular piston, means defining an outlet passage connected through said further check valve means to the interior of said tubular piston, an elastic annular flange formed integrally with said closure cap and projecting with clearance downwardly into said cylinder and surrounding said tubular piston with clearance thereby defining a first annular gap between the upper part of said cylinder wall and said annular flange, said cylinder wall having an aperture formed therein through which said first gap communicates with the interior of said container and a second annular gap between said tubular piston and said annular flange communicating with the atmosphere, both of said gaps and said aperture defining a passage allowing atmospheric air to flow into said container when said tubular piston is depressed, and sealing means moving with said piston and cooperating with said annular flange for controlling the passage of atmospheric air into said container, said sealing means forming a tight seal when said tubular piston is urged by said spring means into said normal position of rest.

2. A small piston pump made of molded or pressed parts of thermoplastic material for discharging small amounts of liquid or paste out of a container, said pump comprising a cylinder attached to a closure cap of said container, suction valve means arranged in the bottom of said cylinder, a suction tube extending from the bottom of said cylinder to adjacent the bottom of said container, a tubular piston slidably guided within said cylinder and extending upwardly out of said cylinder, and outwardly through said closure cap, spring means arranged within said cylinder and said tubular piston urging said piston upwardly into its position of rest, said piston being actuated from outside against the force of said spring means, an elastic sealing collar provided at the lower end of said tubular piston formed by two annular lips with outwardly tapering walls extending in opposite direction so as to include an outwardly open obtuse angle, said lips sealingly bear against the cylinder wall, pressure valve means arranged in the upper part of said tubular piston controlling an outlet passage through said tubular piston, an elastic annular flange provided on said closure cap and projecting with clearance downwardly into said cylinder and circumpassing said tubular piston with clearance thereby forming a first annular gap between the upper part of said cylinder wall and said annular flange, said first gap communicating through an aperture in the upper section of said cylinder wall with the interior of said container, and a second annular gap between said tubular piston and said annular flange communicating with the atmosphere,

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both gaps and said aperture forming a passage allowing atmospheric air to flow into said container when said tubular piston is depressed, and valve means controlling the passage of atmospheric air and forming a tight seal when said tubular piston is urged by said spring means into its upper position of rest.

3. A small piston pump according to claim 2, in which the lower end of said elastic annular flange of said closure cap sealingly engages an upwardly covering cone surface provided on the outer circumference of said tubular piston when said piston is in its position of rest thereby forming said valve means controlling the admittance of atmospheric air.

4. A small piston pump according to claim 3, in which the inner surface of said elastic annular flange of said closure cap conically converges downwardly the lower end contacting the shank of said tubular piston which on occurrence of an underpressure within said container will be lifted at least partly away from the shank of said piston.

5. A small piston pump according to claim 2, in which a conical upwardly diverging cone surface is provided at the lower end of said elastic annular flange of said closure

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cap, against which cone surface the free end of the upper lip of said sealing collar is pressed, when said tubular piston is in its position of rest, thereby forming said valve means controlling the admittance of atmospheric air.

6. A small piston pump according to claim 3, in which said sealing collar is an integrally molded or pressed part of said tubular piston.

7. A small piston pump according to claim 2, in which said sealing collar is formed by a separate part and comprises an axial tubular upper extension inserted into an inner recess of said tubular piston provided at the lower enlarged end thereof.

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